A STUDY OF SPOTTED DEER AND BLACKBUCK IN GUINDY NATIONAL PARK, MADRAS - 1992

Report for the Period January to December 1992

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1. INTRODUCTION

The current study of Spotted Deer (*Axis axis*) and Blackbuck (*Antilope cervicapra*) in the Guindy National Park, Madras was undertaken to monitor the populations of the two large mammals and study their behavioural ecology. The study also encompasses aspects of the population dynamics, population structure, grouping behaviour, breeding seasons, feeding habits and habitat preference of the two mammals. The study was undertaken under the guidance of Dr.R.Sukumar, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, and under the auspices of the Tamil Nadu Forest Department.

This is a report for the period January to December 1992 giving the results of the spotted deer and blackbuck censuses and seasonal movements in the Park. A similar report for the year 1991 has already been submitted. In addition, a list of the smaller plants of Guindy National Park and, especially of Polo Field and adjoining areas is given.

2. MATERIALS AND METHODS

: STUDY AREA :

Guindy National Park is situated in Madras city, Tamil Nadu and comprises an area of 270.57 hectares today. Other than the Blackbuck, the park also harbours a sizable population of spotted deer and other mammals like Bonnet macaque (*Macaca radiata*), common mongoose (*Herpestes edwardsii*), small Indian civets (*Viverricula indica*), jackals (*Canis aureus*) and palm squirrels (*Funambulus palmarum*). The park also harbours an astonishing number (about 130) of bird species.

There is a marked diversity of flora - from dense forest to open scrubland and grassland. There are over 350 species of trees, shrubs, climbers, herbs, sedges and grasses, both native and exotic. Species characteristic of the local scrub jungle are *Randia* sp., *Carissa spinarum, Toddalia asiatica, Feronia elephantum, Zizyphus xylopyrus, Dichrostachys cinerea.* (Selvakumar, 1979). The diversity of vegetation here is important as it determines the distribution of the two ungulates in the Park. There are two tanks, occupying a combined area of 30.4 Ha. and two temporary ponds. They remain dry or partially filled for much of the year.

The Park was divided into three main vegetation types for the purposes of censusing: i) **Dense Forest :** characterised by *Acacia planifrons* canopy and a dense undergrowth of *Glycosmis* spp. and *Clausena* spp. This occupies the extreme eastern and western edges of the Park. The vegetation at the western extremity of the park is probably the remnant of the original vegetation of the region (Sukumar, pers. comm.) and it is characterised by the presence of *Acacia sundra* and the exotic cactus *Cereus.* ii) **Scrub :** characterised by *Borassus flabellifer* and malformed palatable shrubs like *Carissa* spp. and *Randia* spp. iii) **Open Meadow:** this occupies a small area of the park (Polo Field) measuring 180 X 135 metres with over 60 species of herbs, sedges and grasses (see APPENDIX II).

: STUDY METHODS :

Transects: Censusing was done by line transects using stratified random sampling. Three transects were placed randomly, and each transect was walked once in the morning (between 0600 and 0900 hrs) and once in the evening (between 1600 and 1900 hrs) every month. Thus, a total of about 6 km of transect was walked every month. The transects, each about 1 km in length, were placed in the two main vegetation types in the park, one in the dense forest and two in the scrub. The lengths of the transects were estimated using the stride measurement of the observer. The length of the transects are roughly proportional to the area under that vegetation type. The computer program TRANSECT was used to estimate population density of spotted deer and blackbuck. Program TRANSECT is a FORTRAN 77 code to analyze line transect data as described by Burnham et al. (1980)

Observations of groups were recorded while walking at a uniform pace of 1.5 to 2 km/hour. Perpendicular distances to the centre of the group were estimated visually for distances <15m. A Range Finder was otherwise used for estimating perpendicular distances. A 7X50 binoculars was used for observations. The censusing was done by the author, alone, to minimise disturbance.

List of Plants: No detailed list of the smaller herbs, grasses and sedges of Guindy National park was known to exist prior to this study. Since these are potentially very important as food plants of blackbuck and spotted deer which are predominantly grazers, systematic plant collections were made from different parts of the Park. Plants collected after the rains, during the period October 1992 to January 1993 were identified with the kind courtesy of Dr.C.Livingstone, Dr.D.Narasimhan and Mr. Ravichandran of the Botany Dept. of Madras Christian College who are preparing a detailed list of the flora of GNP. The list of herbs, grasses and sedges of GNP is presented in APPENDIX I. The list of plants collected from Polo Field and adjoining areas (prime blackbuck habitat) is provided separately in APPENDIX II.

Census of Blackbuck : Blackbuck exhibit a patchy distribution. Their distribution showed a distinct preference for open and semi-open areas. The polo field is a favourite place where Blackbuck congregate in fairly large numbers. No transect passed through Polo Field where there is usually a large number of Blackbuck. Hence, total counts were made each month, of the Blackbuck on the open meadow in the mornings and evenings before or after the regular transects were done. The density estimate of the TRANSECT program was extrapolated to the rest of the Park (excluding polo field) and the total figure so derived was then added to the average of the counts done on the meadow (Polo Field) to get the total number of Blackbuck in the park. A total count of the blackbuck in the Raj Bhavan area was attempted on foot at the end of the year.

3. SPOTTED DEER *(Axis axis)*

: ESTIMATION OF DENSITY & POPULATION SIZE:

: *Data Features* : The TRANSECT analysis has been used for all the monthly transect data. The data were grouped into 10 perpendicular distance intervals, each of 5 metre width, (0-5m, 5-10m .. and so on upto 45-50m) for entry into the program. The data were truncated at 50 metres width, i.e. sightings of groups more than 50 metres away from the transect line were omitted in the analysis. A total of 317 sightings of spotted deer were made. Truncation, as above meant excluding 77 (19%) sightings which were beyond 50 m from the transect line. Burnham *et al.* (1980) recommend exclusion of outliers, or 5-10% of the sightings which are at farthest distances from the transect line, as these have little effect on the density estimate, but complicate the estimation process. Hence, alternate perpendicular distance ranges of 10 metres each (0-10m, 10-20m ... 70-80m) were tried and the both the Fourier Series (FSER) and Half Normal (HNOR) estimators were used to estimate density. Here, only 5% (20) of the outlying sightings were excluded.

: *Results and Discussion* :

The Fourier Series estimates for both the perpendicular distance interval widths puts the mean density of *groups* at about 92/km^2. The mean group size in the National Park was calculated from complete groups seen between *0600-0900* hrs and between *1600-1900* hrs - the times when transects were done (**N** = 1434). The mean density of groups multiplied by the mean group size gives an mean individual density (10m intervals) of 233 deer / sq. km. The Mean Total Population of chital is thus 631 animals plus or minus about 91 animals (95% confidence interval) (see Table 1). This may be an overestimate for reasons outlined below and further statistical analysis is in progress to resolve the issue.

Table 1 : Spotted Deer Density in Guindy National Park 1992

S. No	Time Period	Estimator	Perpendicular dist. data type	N	Mean Density of Groups (Dg) /km2	Mean Density of Deer (D) /km2	%age Coefficient of Varn. %Cv	95% Confidence Interval of D /km2	Total Pop. Mean	95% C.I. of Total Pop.
1.	Jan to Dec	FSER	5m widths	336	94.7	243.5	7.8	206.1-280.6	659	558-719
2.	Jan to Dec	HNOR	5m widths	336	78.0	200.6	7.2	172.2-228.9	543	466-619
3.	Jan to Dec	FSER	10m widths	384	90.7	233.1	7.3	199.5-266.8	631	540-722
4.	Jan to Dec	HNOR	10m widths	384	69.4	178.4	6.5	155.7-201.1	483	421-544

FSER - Fourier Series Estimator HNOR - Half Normal Estimator
N - Sample Size C.I. - Confidence Interval Pop. - Population

The FSER estimates of the population density are probably slightly on the higher side. The transect through the forest may have contributed towards this overestimate as it was somewhat close to and almost parallel to a major road for a sizable stretch. Also, during the wet season large numbers of deer congregate in and use Polo Field and nearby scrub areas which may have been oversampled, relative to areas of the Park frequented by less deer. The 10m widths data are more reliable since it does not exclude a high percentage of the outliers. The estimates are also probably higher due to statistical reasons (Sukumar, pers. comm.). Hence the above data is currently still under analysis and correction and rigourous statistical procedures are being applied.

Due to the above constraints, in this report the HNOR estimator of 10m widths data is being used. The HNOR estimator gives the least coefficient of variation, and in the experience of the observer also probably gives the best estimate. *Thus, the total population is 421-544 deer and a figure of 483 deer, or a density of 178 deer / km^2, can be used for convenience.* It is noted that the

Half Normal Estimator (HNOR) gives values dissimilar to those of the Fourier Series Estimator (FSER). It is also noted that the population size and density of the spotted deer population in Guindy National Park is significantly higher than the 1991 results (Raman, 1991). This seems to indicate a trend of increase in the spotted deer population. However, due to the various reasons given above, plus the fact that the study has encompassed only two years so far, and pending further statistical analysis, no definite conclusions are drawn here as to whether the deer population is increasing or stable.

A comparison of the spotted deer density estimate with densities in other natural areas and with past estimates for Guindy National Park has been made elsewhere (Raman, 1991).

SPOTTED DEER : SEASONAL HABITAT USE & MOVEMENTS

Though detailed notes of the foraging behavior and feeding ecology of chital were not taken, observations were made to study seasonal usage of the three main habitat types (see section 2) by spotted deer. The replicate data from the two transects in the scrub and the single transect in the forest were pooled separately to come up with density estimates for these two vegetation types. The data were grouped into 5 metre widths and truncated at 30m for the forest transects and at 50m for the scrub for convenient analysis.

It was noted that the pattern of seasonal habitat use in 1992 was similar to that reported for 1991 (Raman, 1991). Hence, the data for each season for 1991 and 1992 have been pooled. Thus the seasonal data reported below are for the period 1991-92.

Pooling the data for the whole year showed no significant difference in density of chital in the two habitats (Raman, 1991). However, there are marked seasonal variations in usage of these two habitats, judging from the chital densities. Miura (1981) reports even diurnal variation in habitat use during the dry season.

Dry Season : January to March in Madras (Minambakkam) are the months of least rainfall -23.8mm, 6.3mm and 15.1 mm for Jan, Feb & Mar respectively. (Source: Climatological Table, India Meteorological Dept., based on obs. from 1931 to 1960). In January, considerable numbers of chital are still seen in the scrub and polo field. But as the season progresses and the grasses in these areas become dry, chital start utilising the forest habitat where they feed on fallen fruits such as those of *Ficus benghalensis*, *Tamarindus indica*, *Acacia planifrons*, *Prosopis juliflora* etc. A lot of browsing is also seen - on leaves of *Randia* sp., *Carissa spinarum*, *Cassia marginata*, *Maytenus emarginatus* and even *Prosopis juliflora* etc. Chital do frequent the scrub early in the morning and late in the evenings, and use the forest during the hotter parts of the day (Miura, 1981), resting in the shade.

Summer or Pre-Monsoon Season : With the increase in temperature and the number of hours of daylight this season is characterised by greatly increased usage of the forest habitat by chital (S.No.2, Table 2). The density of chital in the forest (350.3/km²) becomes significantly higher than the density (135.8/km²) in the scrub. The undergrowth is sparse and the visibility improves considerably. A combination of these factors led to marked increase in the sightings of deer in this vegetation. Chital were also seen to come to the tank/pond to drink between 0700 and 0830 hours. By 0830 most chital sought shade from the heat under large trees and in well wooded areas.

It must be noted that the drop in mean chital density in the scrub and the increase in the forest is not statistically significant compared to the previous season's values. But I believe, from my observations that the change in the mean density itself may be a good indication of the actual trend, despite visibility changes.

Table 2:Seasonal Habitat Use by Chital in Guindy National Park, 1991-2.

S.No	Veget-ation Type	Season	Sample Size (N)	Mean Density of Groups (Dg) /km2	%age Coefficient of Varn. %Cv	Std. Error of Dg	Mean Density of Deer (D)/km²	95% C.I. of D /km2
1.	Scrub	Dry	96	59.1	13.4	7.925	122.3	90.2-154.5
	Forest	Dry	53	147.5	14.8	21.84	315.7	224.1-407.2
2.	Scrub	Summer	80	63.5	13.9	8.845	135.8	98.8-173.0
	Forest	Summer	46	149.7	16.3	24.39	350.3	238.4-462.2
3.	Scrub	Wet	284	90.1	9.6	8.667	337.9	274.2-401.6
	Forest	Wet	40	41.9	20.1	8.458	94.5	57.2-131.8

C.I. - Confidence Interval
Dry Season - Jan-Mar 1991 & 1992
Summer or Pre-Monsoon Season - Apr-May 1991 & Apr-Jun 1992
Wet or Monsoon Season - Jun-Dec 1991 & Jul-Dec 1992

Monsoon or Wet Season : During this period Madras receives rain from both the South-West Monsoon (Jun-Sep) and the North-East Monsoon (Oct-Dec). The heaviest rainfall month is November with a mean total rainfall of 308.7mm. In 52 54 km of transects through the scrub there were 284 sightings of chital herds, and only 40 sightings in 25 km through the forest. With the first monsoon showers fresh grass sprouted in the scrub areas and with continued good rains the chital moved back into the scrub. The chital density in the scrub rose significantly from the 135.8 of summer to 337.9 chital/km². This density was significantly higher than the density in the forest - which was 94.5/km². The density in the forest was a significant drop from the previous season. During this season, chital were mostly seen grazing. Towards December the incidence of browsing increased, especially on *Randia* sp., *Carissa spinarum*. Chital also fed on the fruits of Jamun *Syzygium cumini*, Mahwa *Bassia longifolia*, leaves of *Zizyphus xylopyrus* etc.

The density of chital in the scrub during the SW & NE Monsoon periods did not differ significantly. The mean densities were : 265.7 and 382.6/km² respectively.

My observations during the regular classification counts corroborated the above trends in habitat use, including the steep decline in chital density in the forest from the summer months to the wet season. Yet, the density estimates for the forest vegetation were derived from small sample sizes and may be inaccurate. Also, the transect through the forest was quite close and almost parallel to a major road for a sizable stretch. This, along with statistical and other problems mentioned earlier, may have contributed to successive overestimates, though the trend itself can still be perceived.

4. BLACKBUCK

: ESTIMATION OF DENSITY & POPULATION SIZE:

: ***Data Features*** : The TRANSECT Program (Fourier Series Estimator) was used for density estimation. The data were grouped into ten 5 metre perpendicular distance intervals and also into eight 10 metre intervals for analysis.

: ***Results*** :

The density of Blackbuck in the Park area excluding Polo Field (i.e. about 99% of the area) is about 15 Blackbuck per square kilometre. The density estimation using 10 metre intervals gives a smaller percentage coefficient of variation. This estimate puts the total population of Blackbuck in the park area excluding Polo Field at 41 animals (95% Confidence interval = 30 - 53 animals). The Mean number of Blackbuck frequenting Polo Field was calculated from total counts made every month. The mean was 14.0 (N = 88), with a standard error of 0.98. (see Table 3). As in the case of the spotted deer densities, pending further data analysis, the ten metre distance intervals data is used here.

Table 3 : Blackbuck Density in Guindy National Park 1992
- Excluding Polo Field -

S. No	Time Period	Estimator	Perpendicular dist. data type	N	Mean Density of Groups (Dg) /km2	Mean Density of Blackbuck (D)/km2	%age Coefficient of Varn. %Cv	95% Confidence Interval of D /km2	Total Population (Mean)	95% C.I. of Total Pop.
1.	Jan to Dec	FSER	5m widths	44	10.5	19.0	17.9	12.3-25.7	51	33-69
2.	Jan to Dec	FSER	10m widths	48	8.48	15.3	14.4	11.0-19.7	41	30-53

N - Sample Size Pop. - Population C.I. - Confidence Interval

Blackbuck Population Size :

Adding the number of animals on Polo Field with the number estimated for the rest of the area gives a ***Total Population of 55 Blackbuck in Guindy National Park*** (95% Confidence interval = 44 - 67 Blackbuck, see Table 4).

Table 4 : Blackbuck Population Size in Guindy National Park

Population in the Park (excl Polo Field) (Pp) (Mean)	**95% C.I. of Pp**	**Mean Number on Polo Field** (N = 34) **(Pf)**	**Total Pop. in The Park (Mean)** P = Pp + Pf	**95% C.I. of P**
41	30 - 53	14.0	55	44 - 67

All units are Numbers of animals.

Blackbuck in Raj Bhavan Area:

A total count was attempted on foot in the Raj Bhavan area on 30.12.1992. The total count is a good method to follow in Raj Bhavan since the visibility is good, the area is small, and the animals are confiding and not very shy. The results of the count are given below.

Total Count of Blackbuck in Raj Bhavan

Adult Males - 4
Yearling/Juvenile Males - 6
Yearling/Adult Females - 13
Fawns - 2

TOTAL = 25

Thus a total of 25 blackbuck are found in Raj Bhavan. This total includes one adult male and 7 females within the Governor's Garden, where a few blackbuck may have been missed. Combined with the population of about 55 blackbuck in G.N.P., this figure of 25 blackbuck in Raj Bhavan gives a total of 80 blackbuck in the whole area. This is less than the guess estimate of 100-125 blackbuck reported last year (Raman, 1991) when a census of Raj Bhavan could not be accomplished. The actual figure is probably about 70-90 animals in both the compounds taken together.

Discussion :

The mean density of Blackbuck in the Park (including Polo Field) is 20.3 / km^2 - for the period January to December 1992. This figure is much lower than the figures reported for previous years. For example, an average of 6 census (by means of headcounts and transects) estimates for the period 1975-80 gives the population figure as 295 animals (or 91 animals / km^2) in an area of 800 acres. The average figure of 4 censuses (using transects) in 1981-82 is 333 animals (or 103 / km^2) (Menon, pers. comm.). Selvakumar (1979) also reports a high density of 104 Blackbuck / km^2 and estimated that there were about 260 Blackbuck in the Park (area: about 250 ha.) in 1979. Menon (1983) remarks that due to the patchy distribution of Blackbuck, the transect estimates may be higher than the actual figure.

During this study, a high density of Blackbuck was seen only at the Open Meadow (Polo Field) and some small adjoining areas. Only small dispersed herds of

Blackbuck were seen at other places in the Park. My observations and walks through the various areas of the Park tally with and confirm the low densities estimated. Two males were often seen in the *Brachiaria mutica* Grass plot. However no females were seen accompanying them.

From my observations, I believe that Blackbuck do not exist in such numbers in Guindy National Park and Raj Bhavan; as reported by the previous observers quoted above; any more. The population of blackbuck has declined from about 260 animals in 1979 (Selvakumar, 1979) to about 80 today - a decline of about 67% over a period of about 10-12 years. The possible reasons for this decline are outlined elsewhere (Menon, in prep.).

BLACKBUCK : HABITAT USE AND SEASONAL MOVEMENTS

Blackbuck exhibit distinct preferences of habitat in the 2.7 km² Park area.

Polo Field: Most Blackbuck congregated on the open meadow (Polo Field), where the mean Blackbuck density for the year was 467/km². (i.e. an average of 14 animals in an area of 0.03 km²). This high density is perhaps a significant indication of the animals' preference for open terrain and is also presumably related to the availability of grass species on which they graze. In the summer months, when the grass is dry, fewer animals are seen on Polo Field. (Raman, 1991).

Scrub and Dense Forest: Blackbuck were also frequently seen in the scrub vegetation, which comprises of open and semi-open areas, throughout the year. During the wetter months (Aug to Jan), Blackbuck were never seen in the dense forest vegetation. With the onset of summer and consequent scarcity of grass in the meadow and scrub, the animals were observed to move into the forest zone in search of forage. Blackbuck were seen in the forest zone often from February to July. They did not frequent the really dense portions, but moved in small groups at forest fringes, clearings and roads and near the I.I.T. wall where the undergrowth is not very thick. They were repeatedly seen at some of the same spots. They fed on fallen leaf litter of trees such as *Aegle marmelos*, pods of *Pithecolobium dulce* etc. Selvakumar (1979) reporting a similar pattern of habitat use says that blackbuck in the forest also eat fallen leaves of *Zizyphus xylopyrus*, *Acacia planifrons* and pods of *Cassia marginata*. Blackbuck were also seen to feed on the grasses *Cymbopogon flexuosus*, *Heteropogon contortus* and browse on *Randia* sp. and *Sida cordifolia*. 4 Just pros

5. GRASSES, SEDGES AND HERBS OF GUINDY NATIONAL PARK

Since no complete list of the smaller plants of the Park - grasses, sedges, herbs, forbs etc. was available, systematic collections were made of these plants during October 1992 - January 1993. The specimens were identified with the kind courtesy of Dr.C.Livingstone, Dr.D.Narasimhan & Mr. Ravichandran of the Department of Botany, Madras Christian College, Tambaram.

A total of about 350 species of angiosperms have been identified from Guindy National Park so far (Livingstone, pers. comm.). A further 50 or so species may be expected. Of the smaller plants 106 species of herbs/forbs, 54 species of grasses, and 22 species of sedges were collected from the Park. A detailed list is provided in APPENDIX I.

Plants of Polo Field and other Blackbuck areas:

Considering the importance of Polo Field for the blackbuck, separate collections of the smaller plants from Polo Field and some adjoining areas for which blackbuck exhibited a high preference, were made. This yielded 33 species of herbs/forbs, 23 species of grasses, and 11 species of sedges.

The most common grasses of the scrub areas where blackbuck were commonly seen were: *Chrysopogon fulvus*, *Eragrostis viscosa*, *Eragrostiella brachyphylla*, *Perotis indica*, *Heteropogon contortus* and *Aristida setacea*. Other species such as *Alloteropsis cimicina*, *Cymbopogon flexuosus*, *Cynodon barberi*, *Eragrostis tenella*, *Panicum psilopodium*, and *Aristida adscensionis* were fairly common. In the area near the old riding club just East of Kathan Kollai Tank, the grasses *Isolema laxum* and *Eragrostis viscosa* were common.

On Polo Field itself, the predominant grasses were *Chrysopogon fulvus* and *Perotis indica*. The latter is indicative of the fact that Polo Field is a highly grazed, disturbed area (Narasimhan, pers. comm.). A detailed list is given in APPENDIX II.

6. SUMMARY AND CONCLUSIONS

The present work is an attempt to study the biology of the populations of spotted deer and Blackbuck in Guindy National park. The study concentrates on aspects of population size, structure and dynamics of the two species. The study involved doing regular monthly transects; 3 transects were laid and each was done once in the morning and once in the evening. A system of stratified random sampling was used in laying transects and a total of about 6 km of transect was walked each month. The density estimation for the perpendicular distance data gathered was done using computer Program TRANSECT.

Spotted Deer : The results of the study, for the period January to December 1992 gives the size of the population (mean) of spotted deer as 483 animals (plus or minus 60 animals - 95% confidence limits). This maybe a slightly high estimate and the actual population is probably about 400-450 animals. This density of spotted deer in the Park (178/km²) is higher than the density of most other free-ranging populations of spotted deer. The trend in the population over the last two years seems to be one of increase, but further analysis is required before we can conclude so. The high densities are probably due to minimal predation and human disturbance, variety and quality of habitat.

Blackbuck : The size of the Blackbuck population (mean) is estimated to be 55 animals (plus or minus about 12 animals - 95% Confidence limits). A total count in the Raj Bhavan area attempted on 30.12.1991 gives a figure of 25 Blackbuck. Thus there are about 70-90 blackbuck in G.N.P. and Raj Bhavan taken together. This, and the drop in density from 103.8/km² in 1979 to 15.3/km² in 1992 indicates a marked decrease in Blackbuck numbers.

More detailed reports and suggestions on census techniques and management will be provided at the end of the study.

7. ACKNOWLEDGMENTS

I wish to express my sincere thanks to Dr.R.Sukumar for his valuable guidance and encouragement throughout the project, for allowing access to the CES library and for guidance on using the TRANSECT Program. My most grateful thanks to Mr.R.K.G.Menon, without whose guidance and help this project would have been impossible. I also thank Dr.C.Livingstone, Dr.D.Narasimhan, Mr.Ravichandran and Ms.A.Vasuki of the Dept. of Botany, Madras Christian College for help in identifying plants and useful discussions. I thank Mr.B.Rajasekhar for his help and support.

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APPENDIX II: List of herbs, grasses and sedges of Polo Field and Adjoining Areas

Herbs

1. Alysicarpus monilifer ——— FABACEAE
2. Blepharis molluginifolia ——— ACANTHACEAE
3. Cassia occidentalis ——— CAESALPINACEAE
4. Cassia tora ——— CAESALPINACEAE
5. Catharanthus roseus ——— APOCYNACEAE
6. Commelina attenuata ——— COMMELINACEAE
7. Crotalaria prostrata ——— FABACEAE
8. Croton bonplandianum ——— EUPHORBIACEAE
9. Desmodium triflorum ——— FABACEAE
10. Dipteracanthus prostratus ——— ACANTHACEAE
11. Euphorbia thymifolia ——— EUPHORBIACEAE
12. Evolvulus alsinoides ——— CONVOLVULACEAE
13. Evolvulus nummularius ——— CONVOLVULACEAE
14. Hedyotis puberula ——— RUBIACEAE
15. Heliotropium bracteatum ——— BORAGINACEAE
16. Hemidesmus indicus ——— ASCLEPIDACEAE
17. Hybanthus enneaspermus ——— VIOLACEAE
18. Indigofera linnaeii ——— FABACEAE
19. Justicia prostrata ——— ACANTHACEAE
20. Lepidagathis cristata ——— ACANTHACEAE
21. Lindernia crustacea ——— SCROPHULARIACEAE
22. Mollugo pentaphylla ——— MOLLUGINACEAE
23. Murdannia vaginata ——— COMMELINACEAE
24. Oldenlandia herbacea ——— RUBIACEAE
25. Oldenlandia pusilla ——— RUBIACEAE
26. Phyllanthus virgatus ——— EUPHORBIACEAE
27. Polycarpaea corymbosa ——— CARYOPHYLLACEAE
28. Sida cordifolia ——— MALVACEAE

(contd.)

29. Solanum virginianum ——— SOLANACEAE

30. Spermacoce articularis ——— RUBIACEAE

31. Striga angustifolia ——— SCROPHULARIACEAE

32. Vernonia cinerea ——— COMPOSITAE

33. Zornia gibbosa ——— FABACEAE

Grasses - **POACEAE**

1. Alloteropsis cimicina - Fairly Common

2. Andropogon pumilis -

3. Apocopis mangalorensis - Fairly Common

4. Aristida adscensionis - Common

5. Aristida hystrix - Uncommon

6. Aristida setacea - Common

7. Brachiaria milliformis -

8. Chloris barbata - Uncommon

9. Chrysopogon fulvus - Abundant

10. Cymbopogon flexuosus - Fairly Common

11. Cynodon barberi - Fairly Common

12. Cynodon dactylon - Uncommon

13. Cyrtococcum trigonum -

14. Dactylotenium aegypticum -

15. Digitaria longiflora -

16. Eragrostiella bifaria - Fairly Common

17. Eragrostiella brachyphylla - Common

18. Eragrostis viscosa - Common

19. Heteropogon contortus - Common

20. Panicum psilopodium - Common

21. Panicum trypheron - Fairly Common

22. Perotis indica - Abundant

23. Sporobolus coromandelianus -

(contd.)

Sedges - CYPERACEAE

1. Bulbostylis barbata
2. Bulbostylis puberula
3. Cyperus castaneus
4. Cyperus compressus
5. Cyperus rotundus
6. Fimbristylis argentea
7. Fimbristylis cymosa
8. Fimbristylis ovata
9. Fimbristylis tenera
10. Kyllinga triceps
11. Scleria lithosperma

(contd.)

List of plants of Guindy National Park - HERBS

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1 Acalypha lanceolata --------- EUPHORBIACEAE

2 Achyranthus aspera --------- AMARANTHACEAE

3 Aerva lanata --------- AMARANTHACEAE

4 Alternanthera sessilis --------- AMARANTHACEAE

5 Alysicarpus monilifer --------- FABACEAE

6 Amaranthus spinosus --------- AMARANTHACEAE

7 Aponogeton natans --------- APONOGETONACEAE

8 Asystasia gangetica --------- ACANTHACEAE

9 Blepharis molluginifolia --------- ACANTHACEAE

10 Blumea sp. --------- ASTERACEAE

11 Boerhaavia diffusa --------- NYCTAGINACEAE

12 Canscora sessiliflora --------- GENTIANACEAE

13 Canthium parviflorum --------- RUBIACEAE

14 Carmona retusa --------- BORAGINACEAE

15 Cassia auriculata --------- CAESALPINACEAE

16 Cassia occidentalis --------- CAESALPINACEAE

17 Cassia pumila --------- CAESALPINACEAE

18 Cassia tora --------- CAESALPINACEAE

19 Catharanthus roseus --------- APOCYNACEAE

20 Cleome aspera --------- CLEOMACEAE

21 Cleome viscosa --------- CLEOMACEAE

22 Coldenia procumbens --------- BORAGINACEAE

23 Commelina attenuata --------- COMMELINACEAE

24 Corchorus aestuans --------- TILIACEAE

25 Crotalaria biflora? --------- FABACEAE

26 Crotalaria medicaginea --------- FABACEAE

27 Crotalaria pallida --------- FABACEAE

28 Crotalaria prostrata --------- FABACEAE

29 Crotalaria retusa --------- FABACEAE

30 Croton bonplandianum --------- EUPHORBIACEAE
31 Desmodium triflorum --------- FABACEAE
32 Dipteracanthus prostratus --------- ACANTHACEAE
33 Drosera burmanni --------- DROSERACEAE
34 Eriocaulon cinereum --------- ERIOCAULACEAE
35 Euphorbia corrigioloides --------- EUPHORBIACEAE
36 Euphorbia hirta --------- EUPHORBIACEAE
37 Euphorbia hypericifolia --------- EUPHORBIACEAE
38 Euphorbia thymifolia --------- EUPHORBIACEAE
39 Evolvulus alsinoides --------- CONVOLVULACEAE
40 Evolvulus nummularius --------- CONVOLVULACEAE
41 Furcraea foetida --------- AGAVACEAE
42 Glinus oppositifolius --------- MOLLUGINACEAE
43 Gnaphalidium indicum --------- ASTERACEAE
44 Goniogyna hirta --------- FABACEAE
45 Habenaria roxburghii --------- ORCHIDACEAE
46 Hedyotis biflora --------- RUBIACEAE
47 Hedyotis puberula --------- RUBIACEAE
48 Heliotopium bracteatum --------- BORAGINACEAE
49 Hemidesmus indicus --------- ASCLEPIDACEAE
50 Hybanthus enneaspermus --------- VIOLACEAE
51 Indigofera linifolia --------- FABACEAE
52 Indigofera linnaeii --------- FABACEAE
53 Indonusiella echiodes --------- ACANTHACEAE
54 Iphigenia indica --------- LILIACEAE
55 Justicia prostrata --------- ACANTHACEAE
56 Lepidagathis cristata --------- ACANTHACEAE
57 Leucas diffusa --------- LABIATAE
58 Limnophila indica --------- SCROPHULARIACEAE
59 Lindernia antipoda --------- SCROPHULARIACEAE

60 Lindernia ciliata --------- SCROPHULARIACEAE
61 Lindernia crustacea --------- SCROPHULARIACEAE
62 Lindernia minima --------- SCROPHULARIACEAE
63 Lindernia oppositifolia --------- SCROPHULARIACEAE
64 Lindernia serrata --------- SCROPHULARIACEAE
65 Ludwigia perennis --------- ONAGRACEAE
66 Melochia corchoriflora --------- STERCULIACEAE
67 Merremia tridentata --------- CONVOLVULACEAE
68 Mimosa pudica --------- MIMOSACEAE
69 Mitracarpus villosus --------- RUBIACEAE
70 Mollugo nudicaulis --------- MOLLUGINACEAE
71 Mollugo pentaphylla --------- MOLLUGINACEAE
72 Murdannia vaginata --------- COMMELINACEAE
73 Nymphaea pubescens --------- NYMPHAEACEAE
74 Oldenlandia herbacea --------- RUBIACEAE
75 Oldenlandia pusilla --------- RUBIACEAE
76 Pedilanthus tithymaloides --------- EUPHORBIACEAE
77 Phyllanthus amarus --------- EUPHORBIACEAE
78 Phyllanthus debilis --------- EUPHORBIACEAE
79 Phyllanthus maderaspatensis --------- EUPHORBIACEAE
80 Phyllanthus virgatus --------- EUPHORBIACEAE
81 Polycarpaea corymbosa --------- CARYOPHYLLACEAE
82 Polycarpon tetraphyllum --------- CARYOPHYLLACEAE
83 Polygala arvensis --------- POLYGALACEAE
84 Portulaca sp. --------- PORTULACACEAE
85 Pseudarthria viscida --------- FABACEAE
86 Rhynchosia aurea --------- FABACEAE
87 Rotala verticillata --------- LYTHRACEAE
88 Sauropus bacciformis --------- EUPHORBIACEAE
89 Sida cordata --------- MALVACEAE

90 Sida cordifolia --------- MALVACEAE

91 Solanum virginianum --------- SOLANACEAE

92 Sopubia delphinifolia --------- SCROPHULARIACEAE

93 Spermacoce articularis --------- RUBIACEAE

94 Striga angustifolia --------- SCROPHULARIACEAE

95 Theriophonum minutum --------- ARACEAE

96 Trianthema triquetra --------- AIZOACEAE

97 Tridax procumbens --------- ASTERACEAE

98 Urginea coramandelica --------- LILIACEAE

99 Utricularia polygaloides --------- LENTIBULARACEAE

100 Vernonia cinerea --------- COMPOSITAE

101 Waltheria indica --------- STERCULIACEAE

102 Wickstroemia indica --------- THYMELACEAE

103 Wickstroemia viridiflora --------- THYMELACEAE

104 Xypris pauciflora --------- XYRIDACEAE

105 Zornia gibbosa --------- FABACEAE

List of plants of Guindy National Park - SEDGES

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1 Bulbostylis barbata --------- CYPERACEAE

2 Bulbostylis puberula --------- CYPERACEAE

3 Cyperus aristatus --------- CYPERACEAE

4 Cyperus biflax --------- CYPERACEAE

5 Cyperus castaneus --------- CYPERACEAE

6 Cyperus compressus --------- CYPERACEAE

7 Cyperus distans --------- CYPERACEAE

8 Cyperus rotundus --------- CYPERACEAE

9 Cyperus tenuiculmis? --------- CYPERACEAE

10 Cyperus tenuispica --------- CYPERACEAE

11 Fimbristylis argentea --------- CYPERACEAE

12 Fimbristylis cymosa --------- CYPERACEAE

13 Fimbristylis dichotoma --------- CYPERACEAE

14 Fimbristylis ovata --------- CYPERACEAE

15 Fimbristylis tenera --------- CYPERACEAE

16 Kyllinga monocephala --------- CYPERACEAE

17 Kyllinga triceps --------- CYPERACEAE

18 Mariscus paniceus --------- CYPERACEAE

19 Schoenoplectus articulatus --------- CYPERACEAE

20 Schoenoplectus lateriflorus --------- CYPERACEAE

21 Scirpus squarrosa --------- CYPERACEAE

22 Scleria lithosperma --------- CYPERACEAE

List of plants of Guindy National Park - GRASSES

****

1 Alloteropsis cimicina --------- POACEAE

2 Andropogon pumilis --------- POACEAE

3 Apluda mutica --------- POACEAE

4 Apocopis mangalorensis --------- POACEAE

5 Aristida adscensionis --------- POACEAE

6 Aristida hystrix --------- POACEAE

7 Aristida setacea --------- POACEAE

8 Bothriochloa pertusa --------- POACEAE

9 Brachiaria milliformis --------- POACEAE

10 Brachiaria mutica --------- POACEAE

11 Brachiaria ramosa --------- POACEAE

12 Chloris barbata --------- POACEAE

13 Chloris dolichostachya --------- POACEAE

14 Chrysopogon fulvus --------- POACEAE

15 Coelachyropsis lagopoides --------- POACEAE

16 Cymbopogon flexuosus --------- POACEAE

17 Cynodon barberi --------- POACEAE

18 Cynodon dactylon --------- POACEAE

19 Cyrtococcum trigonum --------- POACEAE

20 Dactyloctenium aegyptium --------- POACEAE

21 Desmostachya bipinnata --------- POACEAE

22 Digitaria bicornis --------- POACEAE

23 Digitaria longiflora --------- POACEAE

24 Echinochloa colonum --------- POACEAE

25 Eleusine indica --------- POACEAE

26 Eragrostiella bifaria --------- POACEAE

27 Eragrostiella brachyphylla --------- POACEAE

28 Eragrostis gangetica --------- POACEAE

29 Eragrostis nutans --------- POACEAE

30 Eragrostis tenella --------- POACEAE

31 Eragrostis viscosa --------- POACEAE

32 Eriochloa procera --------- POACEAE

33 Heteropogon contortus --------- POACEAE

34 Ichnanthus sp. --------- POACEAE

35 Isolema laxum --------- POACEAE

36 Leersia hexandra --------- POACEAE

37 Microchloa indica --------- POACEAE

38 Mnesithea laevis --------- POACEAE

39 Oplisimenes burmanii --------- POACEAE

40 Oplisimenes compositus --------- POACEAE

41 Oropaetium thomaeum --------- POACEAE

42 Panicum maximum --------- POACEAE

43 Panicum psilopodium --------- POACEAE

44 Panicum trypheron --------- POACEAE

45 Paspalidium flavidum --------- POACEAE

46 Paspalum scrobiculatum --------- POACEAE

47 Perotis indica --------- POACEAE

48 Pseudoraphis spinescens --------- POACEAE

49 Sacciolepis mysuroides --------- POACEAE

50 Setaria pumila --------- POACEAE

51 Sporobolus coromandelianus --------- POACEAE

52 Sporobolus diandra --------- POACEAE

53 Tragus roxburghii --------- POACEAE

54 Vetiveria zizanioides --------- POACEAE